



Drinking Water and Groundwater Trust Fund Statewide Private Well Sampling Initiative

Presented by

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NHDES Source Water Protection Conference

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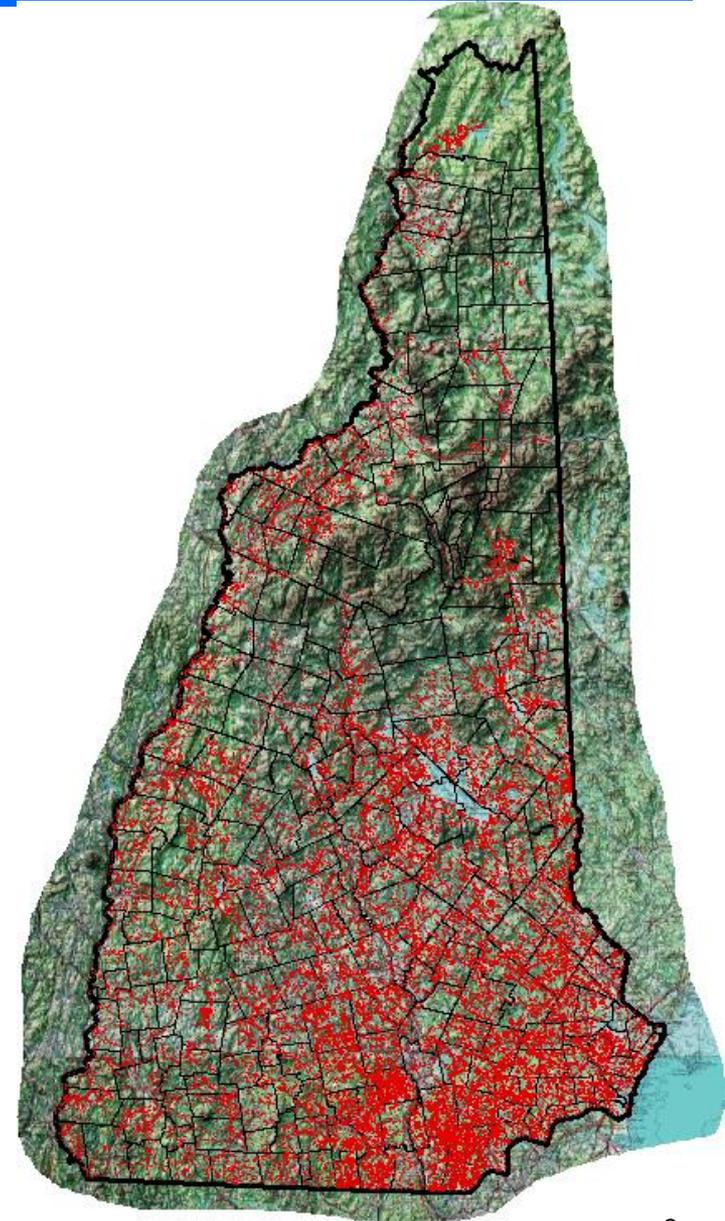
Objectives of the Presentation

- 1. Provide an Overview of the Private Well Testing Program**
 - a) Private wells in New Hampshire**
 - b) Existing data sets**
 - c) Background**
 - d) Study objectives**
 - e) Study approach**

- 2. Using the findings of the study**

Private Wells in New Hampshire

- Approx. 250,000 private wells
- 50% of the state's population
- For wells constructed since 1984
 - Licensed well driller
 - Licensed pump installer
 - Well construction standards
 - Pump installation standards
 - Water Well Board/NHDES administer the requirements
- No statewide requirements for water quality testing
- No requirements to design/install water treatment
- Few towns require initial water quality testing
- NHDES has one full-time person and utilizes other staff to support private well initiatives



Private Wells – Homeowner Sampling

NHDES recommends:

- Bacteria and nitrate/nitrite annually (\approx \$50)
- “Standard Analysis” every three years (\approx \$200)

Chloride	Iron	Lead	pH
Manganese	Copper	Hardness	Sodium
Uranium	Fluoride	Arsenic	Radionuclides

-
- Consider testing for poly and perfluoroalkyl substances (\approx \$175-\$650)

Most homeowners do not regularly test their wells for even a minimal list of parameters

Private Well Sampling Data for New Hampshire

USGS Metals Study (232 private wells were sampled in Southern NH)

Number of Samples = 232	Uranium	Arsenic	Iron	Manganese	Manganese
Standard	>30 ppb MCL	>10 ppb MCL	>300 ppb SMCL	>50 ppb SMCL	>300 ppb LHA
Percent Exceeding Standard	2.6%	17.2%	16.8%	26.7%	5.2%

Drinking Water Well Sampling Data for NH

USGS Arsenic Study (367 public & private wells were sampled in Southern NH)

Arsenic Threshold Value	% Below Threshold Value
<1 ppb	57%
<5 ppb	81%
< 10ppb	89%

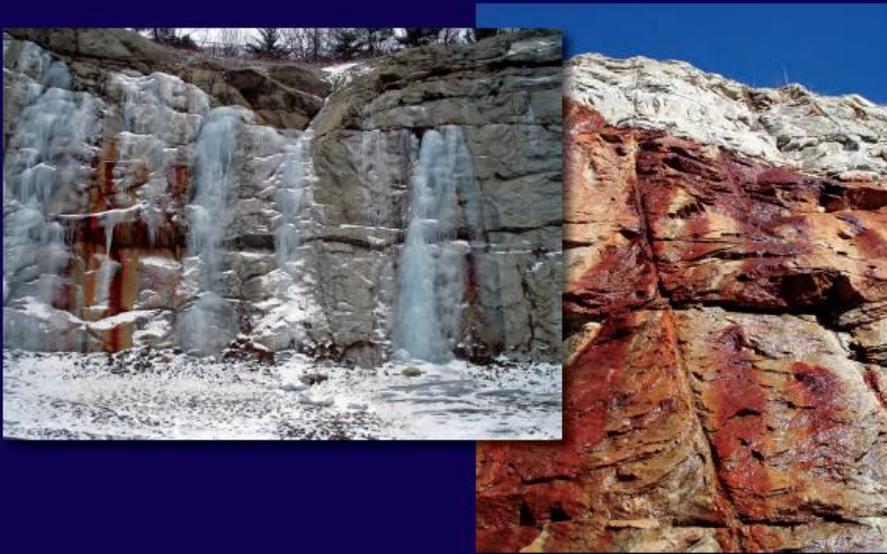
<https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1936-704X.2017.03238.x>

Drinking Water Well Sampling Data for NH



National Water-Quality Assessment Program

Quality of Water from Crystalline Rock Aquifers in New England, New Jersey, and New York, 1995–2007



Scientific Investigations Report 2011–5220
Version 1.1, March 2018

U.S. Department of the Interior
U.S. Geological Survey

Occurrence Information on:

Sodium	Lead
Chloride	Nickel
Fluoride	Zinc
Iron	Arsenic
Manganese	Gross Alpha
Aluminum	Gross Beta
Barium	Radium
Strontium	Radon
Boron	Uranium
Lithium	Radionuclides
Molybdenum	Lead
Beryllium	Organic Compounds
Chromium	Pesticides
Copper	Chloroform
Lead	MtBE

Private Well Testing Conducted by NHDES MTBE Bureau

-  Town Boundary
-  State Boundary
-  Conservation Land
-  Well Sampled by MtBERB

13,631 samples from 8,005 wells

7,776 VOC

3,100 PFAS*

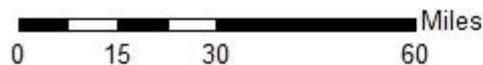
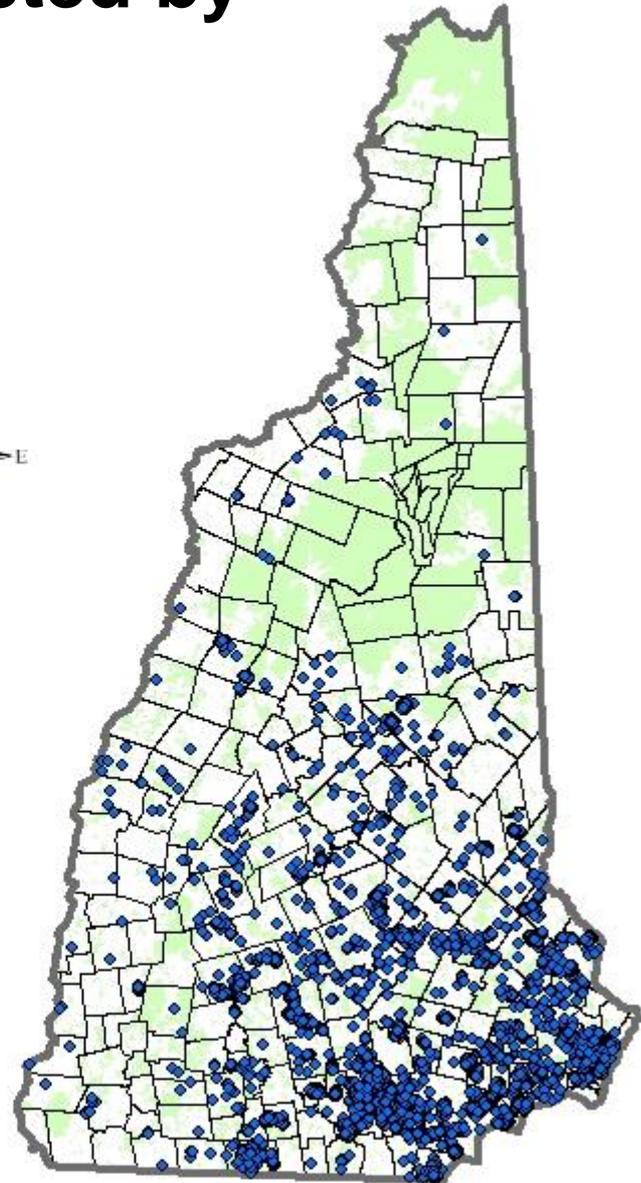
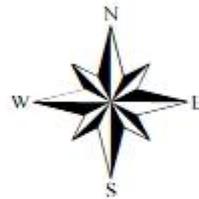
1,482 Standard*

939 Radiological/Radon*

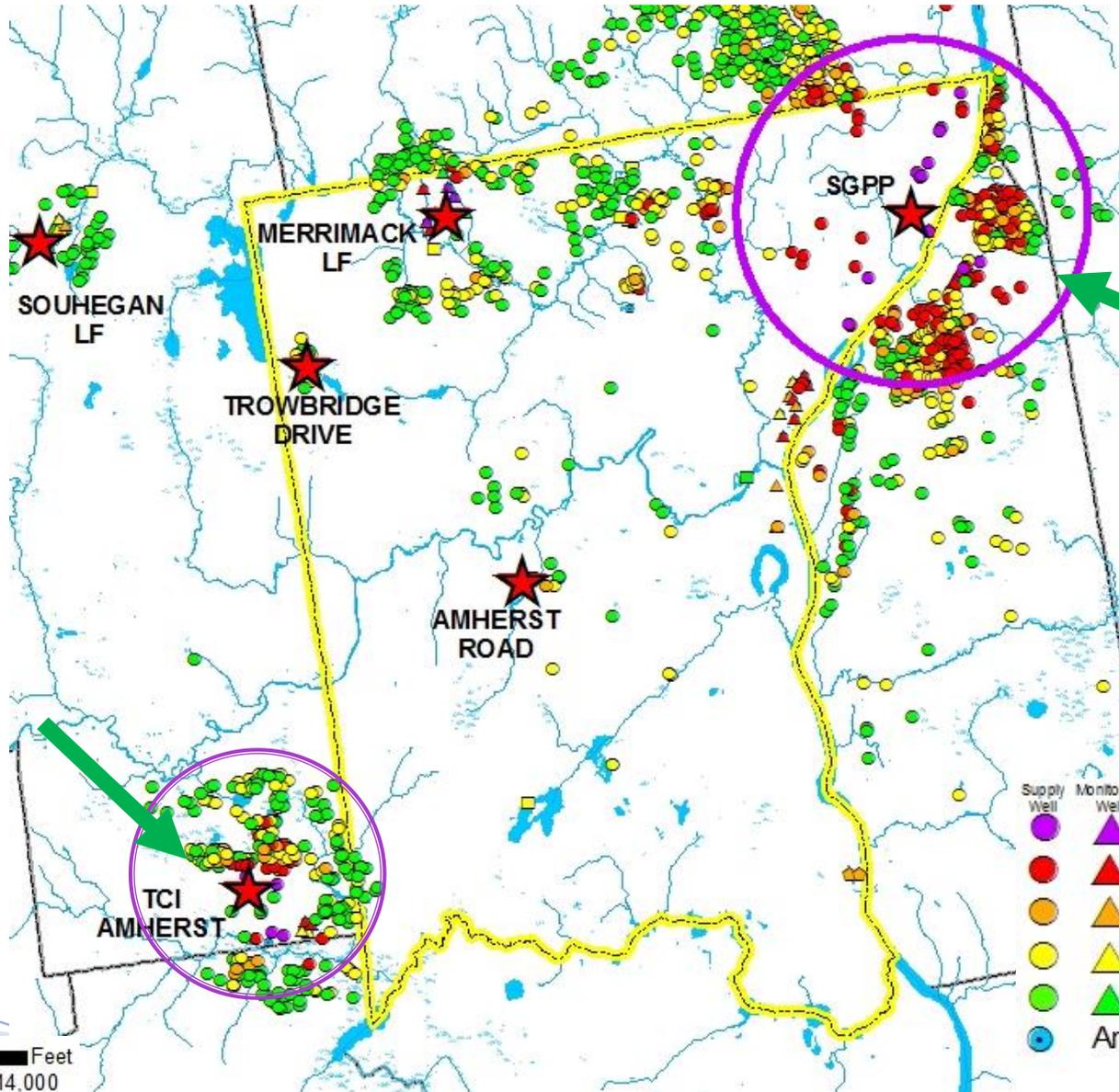
64 Other*

*Analyses paid using non MtBE Settlement Funds

Standard and radiological analyses typically paid for by homeowner at time of sample collection

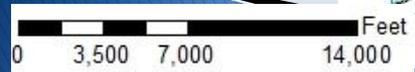
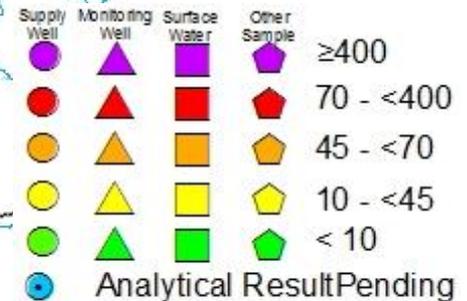


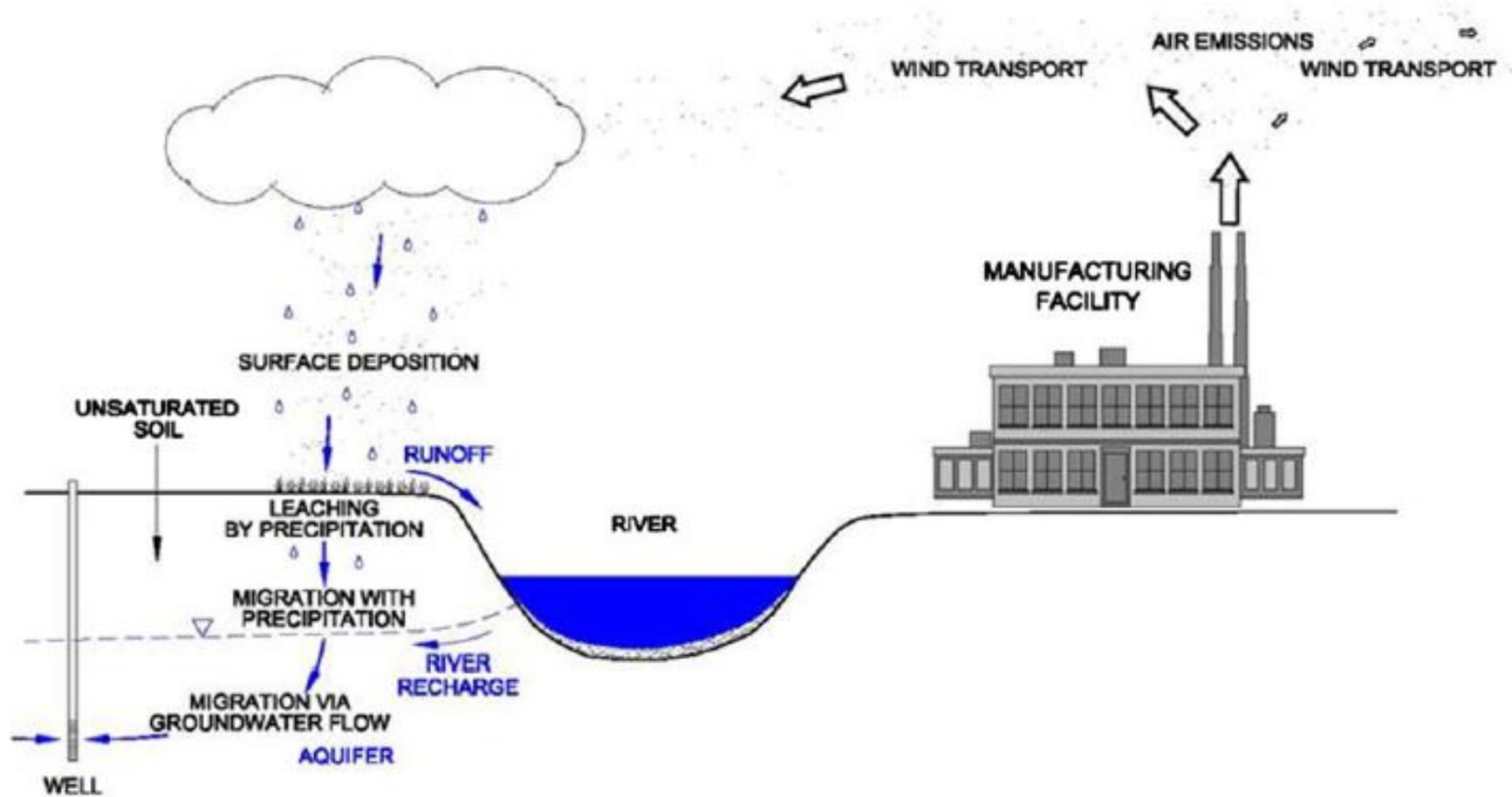
Fabric Coating / Air Emissions



**POEs, ~100
public water
service
connections**

**POUs,
~400+
public water
service
connections**





Davis et al., 2007, *Chemosphere*

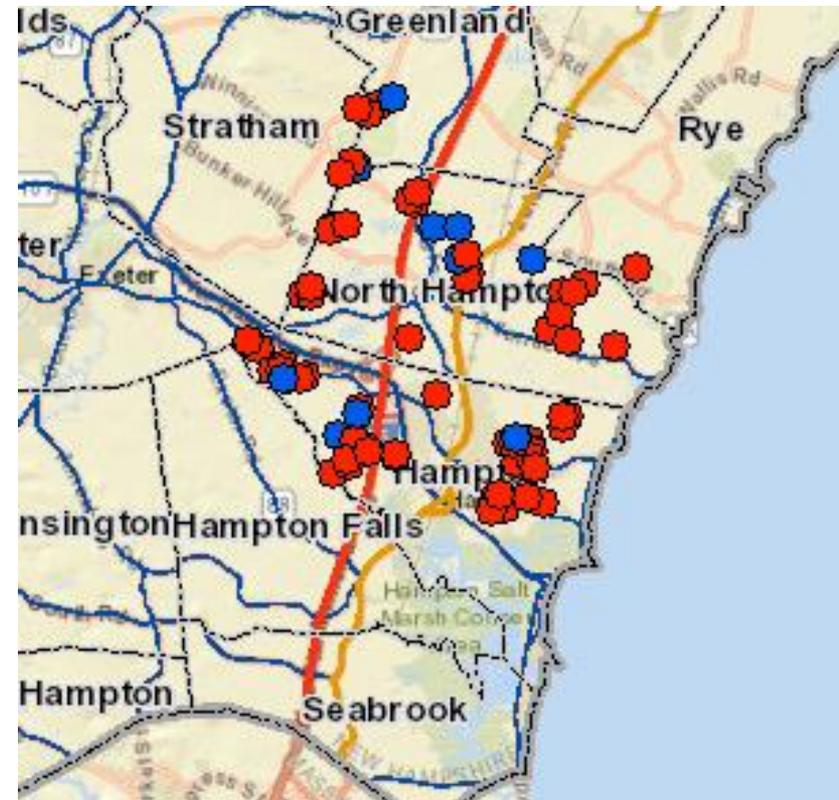
Detection Frequency of PFAS in Private Wells Impacted by Air Emissions

	# of Wells Sampled	Non Detect	Above Detection Limit	Above Detection Limit	>5 ppt	>10 ppt	>20 ppt	>30 ppt	>40 ppt	>50 ppt	>60 ppt	>70 ppt
			Number of Wells									
TOTAL_PFAS	1309	157	88.0%	1152	993	847	680	574	513	449	388	334
PFOS_PFOA	1309	170	87.0%	1139	968	796	586	476	398	320	265	228
PFOA	1309	170	87.0%	1139	962	780	566	462	378	302	247	215
PFHPA	1304	726	44.3%	578	425	224	102	46	30	20	15	10
PFHXA	1015	445	56.2%	570	487	276	110	58	39	25	17	14
PFPEA	1015	648	36.2%	367	290	112	42	23	12	9	5	4
PFBS	1304	1078	17.3%	226	154	52	15	8	5	2	1	1
PFOS	1309	1116	14.7%	193	125	51	23	13	8	5	5	2
PFHXS	1304	1112	14.7%	192	86	28	12	10	7	5	4	3
PFBA	985	895	9.1%	90	67	48	15	8	6	3	3	2
PFPEs	45	41	8.9%	4	0	0	0	0	0	0	0	0
62FTS	920	901	2.1%	19	16	10	8	6	5	4	4	4
PFNA	1304	1285	1.5%	19	3	0	0	0	0	0	0	0
FOSA	970	958	1.2%	12	12	4	1	1	1	1	0	0
PFDA	1015	1004	1.1%	11	2	0	0	0	0	0	0	0

Data collected from 2016-2018 – varying detection limits (~0.5-4 ppt)

NH PFAS Private Well Sampling – No known sources of PFAS contamination

- 77 wells sampled in the seacoast region of NH not near known contamination sites
- Detection limits 0.2 - 0.4 ppt
- Detection in 87% of wells



Summary of Private Well Sampling in an Area of No Known Source of Contamination

	# of Wells	Non Detect	Above Detection Limit	Above Detection Limit	>2 ppt	>5 ppt	>10 ppt	>20 ppt	>30 ppt	>40 ppt	>50 ppt	>60 ppt	>70 ppt
		Number of Wells											
Total PFAS	77	10	87%	67	52	39	26	14	12	7	6	3	3
PFOS/PFOA	77	13	83%	64	44	29	14	3	0	0	0	0	0
PFOA	77	14	82%	63	38	15	6	1	0	0	0	0	0
PFOS	77	25	68%	52	23	10	3	0	0	0	0	0	0
PFBS	66	23	65%	43	17	7	4	1	1	1	0	0	0
PFHXS	77	30	61%	47	10	2	0	0	0	0	0	0	0
PFHXA	70	31	56%	39	13	7	3	0	0	0	0	0	0
PFHPA	76	42	45%	34	8	3	0	0	0	0	0	0	0
PFPEA	69	56	19%	13	13	7	1	1	1	1	0	0	0
PFPEs	6	5	17%	1	0	0	0	0	0	0	0	0	0
PFNA	76	69	9%	7	1	0	0	0	0	0	0	0	0
PFDA	70	69	1%	1	0	0	0	0	0	0	0	0	0
PFHPS	69	68	1%	1	0	0	0	0	0	0	0	0	0

Detection limits ~ 0.2 – 2.7 ppt

Drinking Water Groundwater Trust Fund (DWGTF) Sampling Initiative

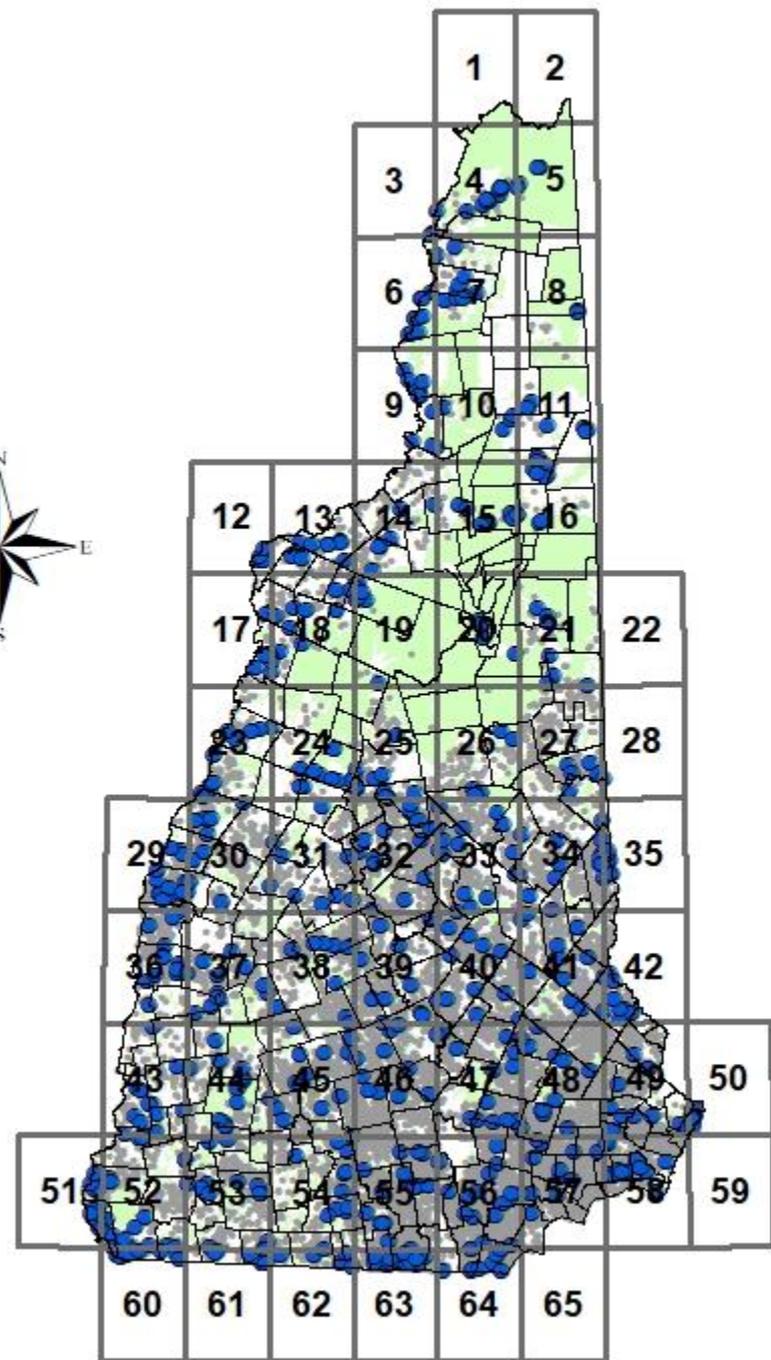
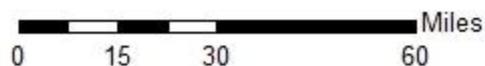
- In 2018 DWGTF authorized 500k to sample private wells for a broad array of contaminants
- NHDES developed a draft sampling plan
- Solicited comments from entities
 - USGS
 - Dartmouth
 - Department of Health and Human Services (biomonitoring)
 - Department of Agriculture (pesticides)
 - Internal stakeholders
- Developed request for proposal for lab services/award contracts
- Refined the sampling program
- Developed data reporting tools
- Sampling program initiated in 2019

DWGTF Sampling Program

-  Town Boundary
-  Quadrangle Boundary
-  Conservation Land
-  Domestic Well Candidates
-  Randomly Selected Well



Analysis	Count
Standard with Corrosivity	500
Chromium VI	500
Perchlorate	500
1,4-Dioxane	500
VOCs (72 Compounds)	500
PFAS (22 Compounds)	500
Comprehensive Radiological	300
Basic Radiological	200
Pesticides (132 compounds)	150



NOVEL ASPECTS OF THE STATEWIDE SAMPLING PLAN

- May be the first broad/non-targeted assessment of the following in private wells
 - PFAS
 - 1,4-dioxane
 - Perchlorate
 - Chromium VI

} Septic systems, in addition to other traditional sources of contamination can be sources of contamination
- First statewide assessment in New Hampshire of the following in private wells
 - Bacteria
 - Nitrate/nitrite
 - Lead/corrosivity/pH
 - Radionuclides
 - Extended list of pesticides and breakdown products
 - Salt
 - Fluoride
 - Manganese

NOVEL ASPECTS OF THE STATEWIDE SAMPLING PLAN

- Current pesticide sampling in NH is associated with Public Water Systems and Federal Safe Drinking Water Act – 20 pesticides
 - Lab reporting limits are generally at part-per-billion
 - Detections are rare
 - Don't look for break-down products
 - Don't look for pesticides currently in use
 - USEPA last updated pesticide standards in 1992
- Statewide sampling plan will monitor for 132 compounds
 - Part-per-trillion reporting limits
 - Most of the pesticides have USEPA, NHDES or USGS screening levels or standards
 - Based on limited sampling in NH & an extensive sampling in Minnesota, anticipate detections in 25%-50% of the samples

Use of the Results

- Evaluate the concentration & distribution of contaminants in wells
- Evaluate the occurrence, concentration and background levels of certain emerging contaminants including perchlorate, 1,4-dioxane, and PFAS
- Assess variables that may affect groundwater and drinking water quality including:
 - Well type
 - Well construction
 - Well location relative to septic systems or other potential sources of contamination
 - Geographic location and associated density of development
 - Age of home and type of plumbing system

Use of the Results

- Provide information to homeowners about the quality of their drinking water and when necessary, steps that can be taken to improve water quality
 - Water quality data for each homeowner is coming from 3-4 labs
 - Standard lab reports can be very difficult to interpret
 - NHDES has developed a summary report with graphics, color codes and guidance on how to address elevated contamination levels
- Provide information to the Water Well Board relative to any findings about the impact of well construction and location on water quality
- Augment private well water quality outreach initiatives
- Provide water quality data that corresponds with many of the parameters that are being analyzed for in the biomonitoring study

Use of the Results

- Provide information to the medical community to encourage them to promote that patients with private wells sample and treat water
- Holistically assess water quality – Don't just look at results compound by compound, but assess overall detections for each source
- Bacteria
 - Assess the impact of extreme precipitation on the occurrence of bacteria in wells
 - Assess if cautionary information needs to be developed for vulnerable populations
- Assess the impact of salt, corrosivity, pH and geology on lead levels in water

Use of the Results

- Use data viewers and summary reports to share data with the public
- Provide all results to the public in the Environmental Monitoring Database
 - Public can usually access this data online
 - Data geolocated – readily can be imported into GIS
- Form workgroups with stakeholders to review and use the data and develop outreach initiatives

Well Water Testing Summary - Raw Water

3/22/2019

Address:
Town:

Date Sampled: 12/31/2018
Sampler:

Health limits are based on Maximum Contaminant Levels (MCL) adopted by the U.S. Environmental Protection Agency (USEPA) or drinking water standards adopted by the NH Department of Environmental Services (NHDES).

Health goals are based on non-enforceable Maximum Contaminant Level Goals (MCLG) adopted by USEPA.

Screening levels are based on assessments conducted by USEPA or the U.S Geological Survey (USGS) and are values below which adverse health effects are not anticipated from one-day or lifetime exposures.

If available, these are listed in the report. Screening level may be omitted.

How to Interpret Your Results

-  The concentration of the chemical is less than half of the health based drinking water limit/goal.
-  The concentration of the chemical was detected in the sample at a level that is more than half of the health based drinking water limit, but is below the limit.
-  The concentration of the chemical was detected in the sample above the health based drinking water limit.

Aesthetic Limit: this value refers to the water's taste, smell, color, etc. and is not health related.

-  The concentration of the chemical was detected below the aesthetic drinking water limit.
-  The concentration of the chemical was detected above the aesthetic drinking water limit.

Chemical	Results	Units	Health Limit	Health Goal	Screening Level	Aesthetic Level
Arsenic	11	ug/l	 10			
Chlorate	150	ug/l		 210	 210	
Copper	0.50	ug/l	 1.3			 1

This column is the result value for your water.

These four columns are described above. When a value is present, a colored icon will appear as a visual aid to help you interpret your result value as compared to each of these columns.

$\mu\text{g/L}$ = micrograms per liter = parts-per-billion (ppb)
 mg/L = milligrams per liter = parts-per-million (ppm)

pCi/L = picoCuries per liter

Standard Analytes						
Chemical	Results	Units	Health Limit	Health Goal	Screening Level	Aesthetic Level
1,4-Dioxane	5	µg/L	x 0.32			
Arsenic	0.50	µg/L	+ 10			
Chlorate	54	µg/L			+ 210	
Chloride	1	µg/L				⊕ 250
Hexavalent Chromium	1	µg/L				
Copper	0.50	µg/L	+ 1.3	+ 1.3		⊕ 1
Fluoride	1	mg/L	+ 4	+ 4		⊕ 2
Hardness (Ca+Mg)	5	mg/L				
Iron	215	mg/L				Ⓜ 0.3
Lead	1	µg/L	+ 15			
Manganese	10	mg/L	x 0.84		x 0.3	Ⓜ 0.05
Nitrate	<3	mg/L	+ 10	+ 10		
Nitrite	0	mg/L	+ 1	+ 1		
Perchlorate	54	µg/L			x 15	
pH	8	NONE				⊕ 6.5-8.5
Sodium	10	mg/L			! 20	
Uranium	10	PCI/L	+ 30	x 0		

Bacteria						
Bacteria Type	Results	Units	Health Limit	Health Goal	Screening Level	Aesthetic Level
E. coli Bacteria	Absent	#/100ml	+ Absent			
Total Coliform Bacteria	55	#/100ml	x Absent			

Radiological						
Chemical	Results	Units	Health Limit	Health Goal	Screening Level	Aesthetic Level
Analytical Gross Beta	11110	pCi/L				
Analytical Gross Alpha	1000	pCi/L				
Radium 226	110	pCi/L	x 5			
Radium 228	1000	pCi/L	x 5			
Radon	0	pCi/L			2000	
Uranium	10	pCi/L	+ 30			

HHS Public Health Initiatives “One Health”

“One Health” refers to the integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment. Together, the three make up the One Health triad, since each is inextricably connected to the others. The goal of One Health is to encourage the collaborative efforts of multiple disciplines-working locally, nationally, and globally-to achieve the best health for people, animals, and our environment.

Aligning the Sampling Program with Other Public Health Initiatives

NH's Antimicrobial Resistance Advisory Workgroup

- NHDES participates in this workgroup
 - NHDES developed the state's medicine disposal policies
 - NHDES has completed or supported studies that measured pharmaceuticals (including antibiotics) in the environment.
 - Wastewater studies in New England show wastewater can contain elevated levels of antibiotic resistant bacteria
 - Large quantities of antibiotics are used for aquaculture and at fish hatcheries
- Private Well Sampling Program does not include testing for pharmaceuticals, but looks for 132 pesticides down to parts-per-trillion concentrations
- Bacteria exposed to pesticides can enable them to evolve resistance to antibiotics more quickly
- Some pesticides are antibiotics or possess anti-microbial properties

Aligning the Sampling Program with Other Public Health Initiatives NH

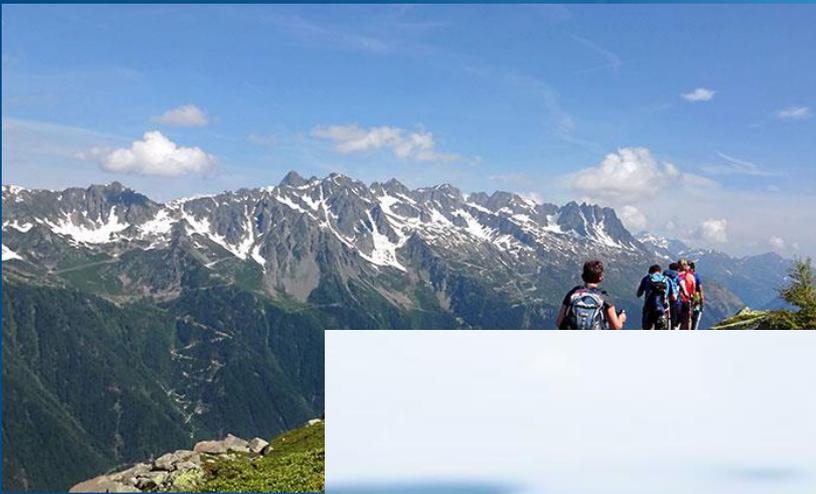
Department of Health and Human Services Biomonitoring Program

- HHS Sampling blood & urine from people in 100-150 households using private wells and analyzing for:
 - Metals
 - PFAS
 - Pesticides & metabolite
 - Nicotine metabolite
- NHDES will follow-up and sample/test the water for many of the same analytes
- Public health studies have much more red tape
 - Confidentiality – NHDES does not get access any personal health information
 - Many levels of approval are require for materials that will be distributed to the public
- Study directly connects environmental data with public health data

What is biomonitoring?

Biomonitoring (noun) – a method for assessing human exposure to chemicals by measuring the chemicals or their metabolites in human tissues or specimens, such as urine or blood (CDC 2005)





NH Tracking and Assessment of Chemical Exposures (TrACE) Study



- 400 NH residents, 6 years and older
- Random recruitment
- Online exposure questionnaire
 - Demographics, work history, recreational activities, food and beverage consumption (including type of water consumed), health
- Testing blood and urine (52 analytes) and home tap water (many PFAS, pesticides, metals, VOCs, and water quality indicators)
- Incentive: \$25 gift card and free water testing!

2019 NH TrACE Study Analyte List



Biomonitoring
New Hampshire

Water Testing

Copper and Lead
(stagnant and flushed)
Iron Sodium
Chloride Fluoride
Uranium pH
Nitrate Nitrite
Total coliform bacteria
Hardness *E. coli*

PFAS

8:2 FTS 6:2 FTS PFBA
PFDS PFHpS PFHxDA
PFTTrDA PFPeA PFTeDA

Other

- Many pesticides, herbicides, and insecticides and their environmental breakdown products
- Corrosives (dissolved solids, alkalinity, pH, sulfur)
- Radionuclides (expanded list: gross alpha, gross beta, radium 226, radium 228, uranium, radon)
 - Chromium-6
 - 1,4 dioxane
 - Perchlorate
 - VOCs

Clinical Testing

Paired Testing!

Metals

Antimony Arsenic Lead
Barium Beryllium Cobalt
Cadmium Manganese Uranium
Selenium Strontium Thallium

PFAS

PFOA PFOS PFHxS PFBS PFNA
PFDA PFDoA PFHxA PFOSA PFHpA
PFUnDA EtFOSAA MeFOSAA

Pesticides/Herbicides/Insecticides*

Cypermethrin Deltamethrin
Methyl parathion Malathion
Chlorpyrifos Permethrin
Cyfluthrin Diazinon
2,4,5-T 2,4-D

Metals

Cesium Tungsten
Mercury, Total Platinum
Molybdenum Tin
Arsenous (III) acid Arsenic (V) acid
Arsenobetaine Arsenocholine
Dimethylarsinic acid (DMA)
Monomethylarsonic acid (MMA)

PFAS

GenX

Pesticides/Herbicides/Insecticides*

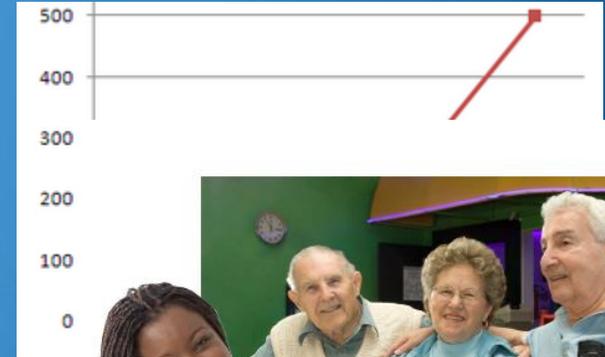
Parathion
Chlorpyrifos methyl

Tobacco

Cotinine

How can we use surveillance data?

- Baseline data specific to NH
- Identify at-risk populations
- Policy recommendations
- Prioritize limited public health dollars



Contact Information



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Questions and Answers